

vary considerably. Therefore, prospective students should be careful in selecting a program. They should contact prospective employers regarding their preferences and ask schools to provide information about the kinds of jobs obtained by graduates, type and condition of instructional facilities and equipment, and faculty qualifications.

Technical institutes offer intensive technical training but less of the general education than do junior and community colleges. Certificates or diplomas based on completion of a certain number of course hours may be rewarded. Many offer 2-year associate degree programs, which are similar to or part of the programs offered by community colleges or State university systems. Other technical institutes are run by private, often for-profit, organizations, sometimes called proprietary schools. Their programs vary considerably in both length and type of courses offered.

Community colleges offer curriculums similar to those in technical institutes but include more courses on theory and liberal arts. Often there is little or no difference between technical institute and community college programs. However, courses taken at community colleges are more likely to be accepted for credit at 4-year colleges than those at technical institutes. After completing a 2-year associate degree program, graduates may obtain jobs as drafters or continue their education in a related field at 4-year colleges. Four-year colleges usually do not offer drafting training, but college courses in engineering, architecture, and mathematics are useful for obtaining a job as a drafter.

Area vocational-technical schools are postsecondary public institutions that serve local students and emphasize training needed by local employers. Many offer introductory drafting instruction. Most require a high school diploma or its equivalent for admission.

Technical training obtained in the Armed Forces can also be applied in civilian drafting jobs. Some additional training may be necessary, depending on the technical area or military specialty.

The American Design Drafting Association (ADDA) has established a certification program for drafters. Although drafters are not usually required to be certified by employers, certification demonstrates that nationally recognized standards have been met. Individuals who wish to become certified must pass the Drafter Certification Test, which is administered periodically at ADDA-authorized test sites. Applicants are tested on their knowledge and understanding of basic drafting concepts such as geometric construction, working drawings, and architectural terms and standards.

Job Outlook

Employment of drafters is expected to grow more slowly than the average for all occupations through 2008. Although industrial growth and increasingly complex design problems associated with new products and manufacturing will increase the demand for drafting services, greater use of CAD equipment by architects and engineers, as well as drafters, should offset this growth in demand. Many job openings, however, are expected to arise as drafters move to other occupations or leave the labor force.

Opportunities should be best for individuals who have at least 2 years of postsecondary training in a drafting program that provides strong technical skills, and who have considerable skill and experience using CAD systems. CAD has increased the complexity of drafting applications while enhancing the productivity of drafters. It has also enhanced the nature of drafting by creating more possibilities for design and drafting. As technology continues to advance, employers will look for drafters having a strong background in fundamental drafting principles with a higher level of technical sophistication and an ability to apply this knowledge to a broader range of responsibilities.

Demand for particular drafting specializations varies throughout the country because employment is usually contingent upon the needs of local industry. Employment of drafters remains highly concentrated in industries that are sensitive to cyclical changes in the economy, such as engineering and architectural services and

durable goods manufacturing. During recessions, drafters may be laid off. However, a growing number of drafters should continue to be employed on a temporary or contract basis, as more companies turn to the personnel supply services industry to meet their changing needs.

Earnings

Median hourly earnings of drafters were \$15.56 in 1998. The middle 50 percent earned between \$12.29 and \$19.73. The lowest 10 percent earned less than \$10.19 and the highest 10 percent earned more than \$24.84. Median hourly earnings in the industries employing the largest numbers of drafters in 1997 are shown below:

Motor vehicles and equipment	\$21.50
Personnel supply services	16.20
Miscellaneous business services	15.60
Fabricated structural metal products	14.30

Related Occupations

Other workers who prepare or analyze detailed drawings and make precise calculations and measurements include architects, landscape architects, designers, engineers, engineering technicians, science technicians, cartographers, and surveyors.

Sources of Additional Information

Information on schools offering programs in drafting and related fields is available from:

☛ Accrediting Commission of Career Schools and Colleges of Technology, 2101 Wilson Blvd., Suite 302, Arlington, VA 22201.

Information about certification is available from:

☛ American Design Drafting Association, P.O. Box 11937, Columbia, SC 29211. Internet: <http://www.adda.org>.

Landscape Architects

(O*NET 22308)

Significant Points

- Over 40 percent are self-employed—four times the proportion for all professionals.
- A bachelor's degree in landscape architecture is the minimum requirement for entry-level jobs; many employers prefer to hire landscape architects who have completed at least one internship.
- Because many landscape architects work for small firms or are self-employed, benefits tend to be less generous than those provided to workers in large organizations.

Nature of the Work

Everyone enjoys attractively designed residential areas, public parks and playgrounds, college campuses, shopping centers, golf courses, parkways, and industrial parks. Landscape architects design these areas so that they are not only functional but beautiful and compatible with the natural environment as well. They plan the location of buildings, roads, and walkways and the arrangement of flowers, shrubs, and trees. Historic preservation and natural resource conservation and reclamation are other important objectives to which landscape architects may apply their knowledge of the environment as well as their design and artistic talents.

Many types of organizations—from real estate development firms starting new projects to municipalities constructing airports or parks—hire landscape architects, who are often involved with the

development of a site from its conception. Working with architects, surveyors, and engineers, landscape architects help determine the best arrangement of roads and buildings. They also collaborate with environmental scientists, foresters, and other professionals to find the best way to conserve or restore natural resources. Once these decisions are made, landscape architects create detailed plans indicating new topography, vegetation, walkways, and other landscaping details, such as fountains and decorative features.

In planning a site, landscape architects first consider the nature and purpose of the project and the funds available. They analyze the natural elements of the site, such as the climate, soil, slope of the land, drainage, and vegetation; observe where sunlight falls on the site at different times of the day and examine the site from various angles; and assess the effect of existing buildings, roads, walkways, and utilities on the project.

After studying and analyzing the site, they prepare a preliminary design. To account for the needs of the client as well as the conditions at the site, they frequently make changes before a final design is approved. They also take into account any local, State, or Federal regulations such as those protecting wetlands or historic resources. Computer-aided design (CAD) has become an essential tool for most landscape architects in preparing designs. Many landscape architects also use video simulation to help clients envision the proposed ideas and plans. For larger scale site planning, landscape architects also use geographic information systems technology, a computer mapping system.

Throughout all phases of the planning and design, landscape architects consult with other professionals involved in the project. Once the design is complete, they prepare a proposal for the client. They produce detailed plans of the site, including written reports, sketches, models, photographs, land-use studies, and cost estimates, and submit them for approval by the client and by regulatory agencies. When the plans are approved, landscape architects prepare working drawings showing all existing and proposed features. They also outline in detail the methods of construction and draw up a list of necessary materials.

Although many landscape architects supervise the installation of their design, some are involved in the construction of the site. However, the developer or landscape contractor usually does this.

Some landscape architects work on a variety of projects. Others specialize in a particular area, such as residential development, historic landscape restoration, waterfront improvement projects, parks and playgrounds, or shopping centers. Still others work in regional planning and resource management; feasibility, environmental impact, and cost studies; or site construction.

Most landscape architects do at least some residential work, but relatively few limit their practice to individual homeowners. Residential landscape design projects usually are too small to provide



A landscape architect reviews plans for a project.

suitable income compared with larger commercial or multiunit residential projects. Some nurseries offer residential landscape design services, but these services often are performed by lesser qualified landscape designers or others with training and experience in related areas.

Landscape architects who work for government agencies do site and landscape design for government buildings, parks, and other public lands, as well as park and recreation planning in national parks and forests. In addition, they prepare environmental impact statements and studies on environmental issues such as public land-use planning. Some restore degraded land, such as mines or landfills.

Working Conditions

Landscape architects spend most of their time in offices creating plans and designs, preparing models and cost estimates, doing research, or attending meetings with clients and other professionals involved in a design or planning project. The remainder of their time is spent at the site. During the design and planning stage, landscape architects visit and analyze the site to verify that the design can be incorporated into the landscape. After the plans and specifications are completed, they may spend additional time at the site observing or supervising the construction. Those who work in large firms may spend considerably more time out of the office because of travel to sites outside the local area.

Salaried employees in both government and landscape architectural firms usually work regular hours; however, they may work overtime to meet a project deadline. Hours of self-employed landscape architects vary.

Employment

Landscape architects held about 22,000 jobs in 1998. About 1 out of 2 salaried workers were employed in firms that provide landscape architecture services. Architectural and engineering firms employed most of the rest. The Federal Government also employs these workers, primarily in the U.S. Departments of Agriculture, Defense, and Interior. About 2 of every 5 landscape architects were self-employed.

Employment of landscape architects is concentrated in urban and suburban areas throughout the country. Some landscape architects work in rural areas, particularly those in the Federal Government who plan and design parks and recreation areas.

Training, Other Qualifications, and Advancement

A bachelor's or master's degree in landscape architecture is usually necessary for entry into the profession. The bachelor's degree in landscape architecture takes 4 or 5 years to complete. There are two types of accredited master's degree programs. The master's degree as a first professional degree is a 3-year program designed for students with an undergraduate degree in another discipline; this is the most common type. The master's degree as the second professional degree is a 2-year program for students who have a bachelor's degree in landscape architecture and wish to teach or specialize in some aspect of landscape architecture, such as regional planning or golf course design.

In 1999, 58 colleges and universities offered 75 undergraduate and graduate programs in landscape architecture that were accredited by the Landscape Architecture Accreditation Board of the American Society of Landscape Architects.

College courses required in this field usually include technical subjects such as surveying, landscape design and construction, landscape ecology, site design, and urban and regional planning. Other courses include history of landscape architecture, plant and soil science, geology, professional practice, and general management. Many landscape architecture programs are adding courses that address environmental issues. In addition, most students at the undergraduate level take a year of prerequisite courses such as English, mathematics, and social and physical science. The design studio is an important aspect of many landscape architecture

curriculums. Whenever possible, students are assigned real projects, providing them with valuable hands-on experience. While working on these projects, students become more proficient in the use of computer-aided design, geographic information systems, and video simulation.

In 1999, 46 States required landscape architects to be licensed or registered. Licensing is based on the Landscape Architect Registration Examination (L.A.R.E.), sponsored by the Council of Landscape Architectural Registration Boards and administered over a 3-day period. Admission to the exam usually requires a degree from an accredited school plus 1 to 4 years of work experience, although standards vary from State to State. Currently, 17 States require the passage of a State examination in addition to the L.A.R.E. to satisfy registration requirements. State examinations, which are usually 1 hour in length and completed at the end of the L.A.R.E., focus on laws, environmental regulations, plants, soils, climate, and any other characteristics unique to the State.

Because State requirements for licensure are not uniform, landscape architects may not find it easy to transfer their registration from one State to another. However, those who meet the national standards of graduating from an accredited program, serving 3 years of internship under the supervision of a registered landscape architect, and passing the L.A.R.E. can satisfy requirements in most States. Through this means, a landscape architect can obtain certification from the Council of Landscape Architectural Registration Boards, and so gain reciprocity (the right to work) in other States.

In the Federal Government, candidates for entry positions should have a bachelor's or master's degree in landscape architecture. The Federal Government does not require its landscape architects to be licensed.

Persons planning a career in landscape architecture should appreciate nature, enjoy working with their hands, and possess strong analytical skills. Creative vision and artistic talent are also desirable qualities. Good oral communication skills are essential; landscape architects must be able to convey their ideas to other professionals and clients and to make presentations before large groups. Strong writing skills are also valuable, as is knowledge of computer applications of all kinds, including word processing, desktop publishing, and spreadsheets. Landscape architects use these tools to develop presentations, proposals, reports, and land impact studies for clients, colleagues, and superiors. The ability to draft and design using CAD software is essential. Many employers recommend that prospective landscape architects complete at least one summer internship with a landscape architecture firm in order to gain an understanding of the day-to-day operations of a small business, including how to win clients, generate fees, and work within a budget.

In States where licensure is required, new hires may be called "apprentices" or "intern landscape architects" until they become licensed. Their duties vary depending on the type and size of employing firm. They may do project research or prepare working drawings, construction documents, or base maps of the area to be landscaped. Some are allowed to participate in the actual design of a project. However, interns must perform all work under the supervision of a licensed landscape architect. Additionally, all drawings and specifications must be signed and sealed by the licensed landscape architect, who takes legal responsibility for the work. After gaining experience and becoming licensed, landscape architects usually can carry a design through all stages of development. After several years, they may become project managers, taking on the responsibility for meeting schedules and budgets, in addition to overseeing the project design; and later, associates or partners, with a proprietary interest in the business.

Many landscape architects are self-employed because start-up costs, after an initial investment in CAD software, are relatively low. Self-discipline, business acumen, and good marketing skills are important qualities for those who choose to open their own business. Even with these qualities, however, some may struggle while building a client base.

Those with landscape architecture training also qualify for jobs closely related to landscape architecture, and may, after gaining some experience, become construction supervisors, land or environmental planners, or landscape consultants.

Job Outlook

Employment of landscape architects is expected to increase as fast as the average for all occupations through the year 2008. The level of new construction plays an important role in determining demand for landscape architects. Overall, anticipated growth in construction is expected to increase demand for landscape architectural services over the long run.

Increased development of open space into recreation areas, wildlife refuges, and parks will also require the skills of landscape architects. The recent passage of the Transportation Equity Act for the Twenty-First Century is expected to spur employment for landscape architects, particularly in State and local governments. This Act, known as TEA-21, provides funds for surface transportation and transit programs, such as interstate highway maintenance and environment-friendly pedestrian and bicycle trails. However, opportunities will vary from year to year and by geographic region, depending on local economic conditions. During a recession, when real estate sales and construction slow down, landscape architects may face layoffs and greater competition for jobs. The need to replace landscape architects who retire or leave the labor force for other reasons is expected to produce nearly as many job openings as employment growth.

An increasing proportion of office and other commercial and industrial development will occur outside cities. These projects are typically located on larger sites with more surrounding land which needs to be designed by a landscape architect, in contrast to urban development, which often includes little or no surrounding land. Also, as the cost of land rises, the importance of good site planning and landscape design grows. Increasingly, new development is contingent upon compliance with environmental regulations and land use zoning, spurring demand for landscape architects to help plan sites and integrate man-made structures with the natural environment in the least disruptive way.

Budget tightening in the Federal Government might restrict hiring in the Forest Service and the National Park Service, agencies that traditionally employ the most landscape architects in the Federal government. Instead, such agencies may increasingly contract out for landscape architecture services, providing additional employment opportunities in private landscape architecture firms.

In addition to the work related to new development and construction, landscape architects are expected to be involved in historic preservation, land reclamation, and refurbishment of existing sites. Because landscape architects can work on many different types of projects, they may have an easier time than other design professionals finding employment when traditional construction slows down.

New graduates can expect to face competition for jobs in the largest and most prestigious landscape architecture firms. The number of professional degrees awarded in landscape architecture has remained steady over the years, even during times of fluctuating demand due to economic conditions. Opportunities will be best for landscape architects who develop strong technical and communication skills and a knowledge of environmental codes and regulations. Those with additional training or experience in urban planning increase their opportunities for employment in landscape architecture firms that specialize in site planning as well as landscape design. Many employers prefer to hire entry-level landscape architects who have internship experience, which significantly reduces the amount of on-the-job training required.

Earnings

In 1998, median annual earnings for landscape architects were \$37,930. The middle 50 percent earned between \$28,820 and

\$50,550. The lowest 10 percent earned less than \$22,800 and the highest 10 percent earned over \$78,920. Most landscape architects worked in the landscape and horticultural services industry, where their median annual earnings were \$33,600 in 1997.

In 1999, the average annual salary for all landscape architects in the Federal Government in nonsupervisory, supervisory, and managerial positions was about \$57,500.

Because many landscape architects work for small firms or are self-employed, benefits tend to be less generous than those provided to workers in large organizations.

Related Occupations

Landscape architects use their knowledge of design, construction, land-use planning, and environmental issues to develop a landscape project. Others whose work requires similar skills are architects, surveyors, civil engineers, soil conservationists, and urban and regional planners. Landscape architects also know how to grow and use plants in the landscape. Botanists, who study plants in general, and horticulturists, who study ornamental plants as well as fruit, vegetable, greenhouse, and nursery crops, do similar work.

Sources of Additional Information

Additional information, including a list of colleges and universities offering accredited programs in landscape architecture, is available from:

☛ American Society of Landscape Architects, Career Information, 636 Eye Street, NW., Washington, DC 20001. Internet: <http://www.asla.org>

General information on registration or licensing requirements is available from:

☛ Council of Landscape Architectural Registration Boards, 12700 Fair Lakes Circle, Suite 110, Fairfax, VA 22033.

Surveyors, Cartographers, Photogrammetrists, and Surveying Technicians

(O*NET 22311A, 22311B, 22521A, 22521B, and 25103B)

Significant Points

- Over 8 out of 10 are employed in engineering services and government.
- Computer skills enhance employment opportunities.

Nature of the Work

Measuring and mapping the earth's surface is the responsibility of several different types of workers. Traditional *land surveyors* establish official land, air space, and water boundaries. They write descriptions of land for deeds, leases, and other legal documents; define air space for airports; and measure construction and mineral sites. Other surveyors provide data relevant to the shape, contour, location, elevation, or dimension of land or land features. *Surveying technicians* assist land surveyors by operating survey instruments and collecting information. *Cartographers* compile geographic, political, and cultural information and prepare maps of large areas.

Land surveyors manage survey parties that measure distances, directions, and angles between points and elevations of points, lines, and contours on the earth's surface. They plan the fieldwork, select known survey reference points, and determine the precise location of important features in the survey area. Surveyors research legal records and look for evidence of previous boundaries. They record the results of the survey, verify the accuracy of data, and prepare plots, maps, and reports. Surveyors who establish boundaries must be licensed by the State in which they work.

A survey party gathers the information needed by the land surveyor. A typical survey party consists of a party chief and several surveying technicians and helpers. The party chief, who may be either a land surveyor or a senior surveying technician, leads day-to-day work activities. Surveying technicians assist the party chief by adjusting and operating surveying instruments, such as the theodolite (used to measure horizontal and vertical angles) and electronic distance-measuring equipment. Surveying technicians or assistants position and hold the vertical rods, or targets, that the theodolite operator sights on to measure angles, distances, or elevations. They may also hold measuring tapes, if electronic distance-measuring equipment is not used. Surveying technicians compile notes, make sketches, and enter the data obtained from these instruments into computers. Survey parties may include laborers or helpers who perform less skilled duties, such as clearing brush from sight lines, driving stakes, or carrying equipment.

New technology is changing the nature of the work of surveyors and surveying technicians. For larger projects, surveyors are increasingly using the Global Positioning System (GPS), a satellite system that precisely locates points on the earth by using radio signals transmitted via satellites. To use this system, a surveyor places a satellite signal receiver—a small instrument mounted on a tripod—on a desired point. The receiver simultaneously collects information from several satellites to locate a precise position. The receiver can also be placed in a vehicle for tracing out road systems. Since receivers now come in different sizes and shapes and the cost of the receivers has fallen, much more surveying work is being done using GPS. Surveyors then must interpret and check the results produced by the new technology.

Cartographers measure, map, and chart the earth's surface, which involves everything from geographical research and data compilation to actual map production. They collect, analyze, and interpret both spatial data—such as latitude, longitude, elevation, and distance—and nonspatial data—such as population density, land use patterns, annual precipitation levels, and demographic characteristics. Cartographers prepare maps in either digital or graphic form, using information provided by geodetic surveys, aerial photographs, and satellite data. *Photogrammetrists* prepare detailed maps and drawings from aerial photographs, usually of areas that are inaccessible or difficult to survey by other methods. *Map editors* develop and verify map contents from aerial photographs and other reference sources.

Some surveyors perform specialized functions that are closer to those of a cartographer than to those of a traditional surveyor. For example, *geodetic surveyors* use high-accuracy techniques, including satellite observations, to measure large areas of the earth's surface. *Geophysical prospecting surveyors* mark sites for subsurface exploration, usually petroleum related. *Marine surveyors* survey harbors, rivers, and other bodies of water to determine shorelines, topography of the bottom, water depth, and other features.

The work of surveyors and cartographers is changing because of advancements in technology. These advancements include not only the GPS, but also new earth resources data satellites, improved aerial photography, and geographic information systems (GIS)—which are computerized data banks of spatial data. From the older specialties of photogrammetrist and cartographer, a new type of mapping scientist is emerging. The *geographic information specialist* combines the functions of mapping science and surveying into a broader field concerned with the collection and analysis of geographic information.

Working Conditions

Surveyors usually work an 8-hour day, 5 days a week, and may spend a lot of time outdoors. Sometimes they work longer hours during the summer, when weather and light conditions are most suitable for fieldwork.